

Improving The Process Of Asphalt Roadway Inspection

Prepared by

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January 31, 2007

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STATE DOCUMENTS

Problem Statement:

The South Carolina Department of Transportation (SCDOT) is charged with the responsibility of systematic planning, construction, maintenance, and operation of the state highway system and providing mass transit services. Having been charged with this responsibility, the Department has initiated a strategic plan that sets direction for its future. The agency has elected to work with the Federal Highway Administration in the planning, development, and implementation of our strategic plan, which looks at what can be accomplished in 3-5 years. The Strategic Plan is also referred to as the "Five Big Rocks". The agency's executive staff has identified five key strategic goals for present and future years:

- Safety
- Maintenance/Preservation
- Resources
- Customer Service
- Employee Development

This project of improving the process of asphalt roadway inspection touches and aligns itself with all five of the above strategic goals. In the agency's District One region of South Carolina, numerous senior roadway inspectors have left the agency due to retirement and reassignment, and much of the task of inspecting the asphalt roadway construction projects has now fallen on the young and less experienced (junior) inspectors. Numerous deficiencies in the roadway are now being observed subsequent to the completion of the paving operations due to this lack of experience. This project is an attempt to investigate improving the process of inspecting roads by SCDOT inspectors during paving operations.

In today's climate the public is demanding quality work and accountability from our state agencies. Due to too few fully experienced inspectors, contractors are now performing work that is not quality

in nature and the under-experienced inspectors are unknowingly allowing poor quality work to occur. These errors go repeatedly undiscovered until senior engineers perform the final inspection, and often the errors cannot be corrected without great difficulty and without unnecessary inconvenience to the traveling public. The image of the Department is being tarnished, and our taxpayer dollars are not being maximized. The public's trust in our agency is eroded when deficient work is performed on our roads. The life of a properly resurfaced roadway can be as long as fifteen years without any further maintenance work being performed. When the Department's roadway inspector is performing his job correctly, the contractor accomplishes his work in accordance with our agency's specifications, which in turn insures the maximum life of the roadway is achieved. This inspection also increases pavement performance and reduces overall life-cycle costs. Because it is economically unfeasible for a contractor to provide a warranty on the work he performs for the SCDOT, our best opportunity to insure the maximum life of the roadway is to provide quality inspection of the contractor's work.

The first "Big Rock" mentioned above is safety. Safety on South Carolina's transportation system and within the agency must be increased. If roads are allowed to be resurfaced and due to inadequate roadway inspection, deficiencies such as improper cross-slopes, pot-holes, bird baths, etc. are allowed to evidence themselves shortly after the work is completed then the safety of the traveling public is compromised. Furthermore, if the proper traffic control is not in place within the work zone and the motorists are not aware of the correct path of travel, then the safety of the Department's personnel and the contractor's personnel is compromised. Secondly, maintenance and preservation have a profound effect on safety, mobility, and economic development in our state. We must preserve our existing system when the opportunity presents itself. With limited dollars the

opportunity to perform the asphalt resurfacing work on a specific road does not come often; therefore, this work must be performed correctly to insure that the life of these repairs will be maximized. The third “Big Rock” in our strategic goals is resources. The people, businesses and industries that we serve are counting on us each and every day. The wise and efficient use of the monies we have to perform resurfacing work is characteristic of our stewardship to South Carolina. Serving the citizens of our state, our customers, is how we earn public trust. Customer service, the fourth “Big Rock” is the cornerstone of our success. By providing a safe and smooth roadway for the traveling public, which lasts the anticipated timeframe, indeed provides the best customer service that we strive to achieve. In order for any state agency to survive in today’s marketplace we must do everything possible to deliver the best value to our customer. It is important to remember that the focus of any improvement process should always be on the customer, and SCDOT’s customer is anyone whose satisfaction depends upon our work. Lastly, our employees are our agency’s biggest assets. By improving the process of inspecting roads by SCDOT inspectors during paving operations, we can also develop the skills and knowledge of our employees.

Simply stated, this project is to investigate improving the process of asphalt roadway inspection. “Process improvement is a way to look at the world that allows you to do things better, cheaper or faster. By using the ideas behind process improvement, you can create products or services that are vastly superior to your competition. This advantage allows you to create a large and loyal group of customers that will last at least until someone else comes up with a better product than yours. Because there are always competitors who are looking for ways to improve their products and increase their share of the customers, you must keep looking for ways to improve your products.”¹ In order to successfully complete the project goals, those ideas behind the process improvement need

¹ Eileen M. Flanigan and Jon Scott, Process Improvement, p. 3

to be identified and implemented in a manner to improve the inspection process. Incremental change with improvements of 25% or greater and with goals that can be attained in 9 to 12 weeks should be attempted.² The approach that should be taken includes the following elements:

- The traveling public (customer) should be the primary focus from the beginning
- Participation from the current roadway inspectors should be required
- Take a process view towards the solution
- Plan on obtaining and measuring results after the process has been implemented
- Require training for the inspectors
- Begin the cycle of process improvement again after we think it is complete

Data Collection:

Charts A-1 and A-2 illustrate the point that the Department's District One region of South Carolina has experienced a loss of senior roadway inspectors.³ Senior inspectors are defined as those fully experienced individuals who possess the ability to control the quality of the prosecution of the asphalt roadway work through the inspection process with limited supervision from their supervisors. SCDOT District One serves six South Carolina counties, with management centrally located in the Columbia District One Headquarters and supported by six satellite construction offices. Chart A-1 shows the loss of senior roadway inspectors from 2001 through 2006 from each of these satellite offices. Chart A-2 illustrates the total loss of veteran inspectors in the District. In 2001 there were 47 very experienced individuals inspecting our roadways when construction activities were in progress, and at the end of 2006 this number has been reduced to just 18, a 62% loss. In general, this loss is due to the retirement of senior inspectors. Chart A-3⁴ is a depiction of the number of SCDOT employees who will complete their TERI commitment in the Engineering Services Department of our agency. Since the inspectors fall into this Engineering Services

² Eileen M. Flanigan and Jon Scott, *Process Improvement*, p. 29

³ SCDOT District Organizational Charts 2001-2006

⁴ OHR Workforce Planning: TERI Details, September 5, 2006

Department, the chart is also an accurate representation of the construction offices in our District. District One will continue to lose senior inspectors due to retirement in the next five years.

At the conclusion of each construction project, a final inspection is performed by senior engineers, contractors, and Department personnel. At this inspection all of the deficient items that are discovered are summarized in a list. Subsequent to this inspection, a final inspection letter is sent from the Department to the contractor and includes this list of items that require correction (punch list items) prior to the final acceptance of the project. In some cases the errors are accepted because they cannot be corrected without much difficulty or inconvenience to the traveling public; and, these are not even listed in the letter. Examples of various types of deficiencies discovered during final inspections of recently resurfaced roads in District One are shown on Pictures A-4 through A-12 and are described as follows:

- Picture A-4 shows a low spot in the pavement on a highly traveled roadway. This low spot creates a bird-bath after a rainfall and is a nuisance to the motorists until the water evaporates. This asphalt area will also experience a premature life as a result of standing water. However, after a paving operation leaves the roadway in this situation, it is extremely difficult to properly repair the area without causing further damages. Therefore, in some cases this problem may not be noted on the final inspection letter as something to be corrected. It should also be noted that an experienced inspector would likely have spotted this area as a problem prior to the paving operation and would have directed the contractor to take appropriate action to insure there would not be a low spot subsequent to the completion of the paving.
- Picture A-5 illustrates a manhole cover that was not properly raised prior to the placement of a 2" lift of asphalt. This depression is a nuisance to the motorists as they feel a bump when they ride over this area in the newly resurfaced roadway. A senior inspector would have insisted that the contractor properly insert a manhole spacer ring on this manhole prior to the resurfacing process. During the final inspection, the senior engineers will insist that the asphalt be cut out and removed around this manhole. A spacer will then be installed and new asphalt will be placed in this area. The area will always have a patched appearance and not be aesthetically pleasing to the public.
- Picture A-6 is an example of the inspector not properly marking the roadway prior to the painting operation. This road should have a white edge line placed 2' from the edge of pavement instead of at the edge as shown, allowing the motorist extra paved shoulder for safety considerations. In all probability, the disposition of this error during the final

inspection will be to leave as is resulting in nothing shown on the final inspection letter as a punch list item. The removal and repainting of this line results in more damage than if left alone.

- Picture A-7 shows a recently resurfaced roadway with dangerous drop-offs at the edge of the pavement. If a motorist accidentally runs off the pavement, it is possible that the vehicle may not recover, resulting in an accident. Although this error can be noted on the final inspection and corrected by the contractor, the traveling public will again be inconvenienced with lane closures and time delays as the correction process is completed.
- Picture A-8 portrays a completed resurfacing project with asphalt debris left on the sidewalks and in the gutter. Once again, this can be easily corrected; however, the inspector has allowed the contractor to leave the debris for weeks until discovered during the final inspection. The damage to the image of the Department is untold when pedestrians and bicyclists travel over this debris. Parents pushing baby strollers over the rocky remains of the asphalt paving process also will be extremely frustrated with the Department's lack of consideration and insensitivity.
- Picture A-9 shows a road construction sign, which is barely visible due to limbs blocking its view. The junior inspector on this project allowed the contractor to place this sign in this location without instructing him to provide visibility by cutting the limbs of the tree. The sign does not provide much, if any, warning to the motorists and could easily result in a work zone accident.
- Picture A-10 illustrates the shoulder of a newly resurfaced road. Although sufficient material has been placed to prevent drop-offs, there exists a very poor stand of grass. This occurs when a junior inspector does not insure the ground is properly prepared prior to the placement of the grass seed. This area will require re-seeding, which will result in the traveling public being inconvenienced with road construction work.
- Picture A-11 depicts a recently resurfaced road where the junior inspector allowed the contractor to feather the asphalt at the end of the limits of construction instead of properly butting the asphalt to a joint. The picture shows how unpleasing this area now appears as well as the rough ride the motorist will experience when traveling over the area. A senior inspector would require the contractor to properly prepare the joint in the asphalt to insure this condition would not exist.
- Picture A-12 shows a recently resurfaced road where the junior inspector was not checking the thickness of the asphalt and allowed the contractor to place the asphalt too thin, which results in a section of roadway that will not reach its design life. This area will require removal and placement of the proper thickness of asphalt resulting in the traveling public being inconvenienced with road construction work and a patched section of roadway.

Final Inspection letters from all of the 6 construction offices in District One, which were written from January of 2001 through December of 2006 for asphalt resurfacing projects, were reviewed. Only those projects were utilized for this report whose inspectors could be clearly identified as either junior or senior. Of the forty projects that were reviewed, 14 had senior inspectors performing the inspection services and 26 had junior inspectors performing the inspections. A review of all of the

deficient items, which were discovered during the final inspections that could be attributed to errors in inspection were listed for each of the six years. Charts A-13 and A-14 illustrate the point that projects inspected by senior inspectors had much fewer deficient items discovered at the time of the final inspection than those inspected by junior inspectors. Chart A-14 shows that the average number of listed deficient items for each project was 14.5 for junior inspectors, and the average number of items for senior inspectors was just 2.4. It should also be noted as stated above that in all probability several deficient items, which were deemed to be uncorrectable, are not even listed on these final inspection letters.

Data Analysis:

Based on the above data, the Department's image, safety, and the comfort of the traveling public would be enhanced greatly if only senior inspectors would perform the inspection of asphalt resurfacing projects. Unfortunately, the number of projects being accomplished at any particular time is more than only senior inspectors can inspect. Therefore, junior inspectors must be utilized to perform repaving inspection services as well. Their current levels of expertise range from minimally experienced to fully experienced (almost prepared to be promoted to a senior level status). Presently, there are not enough sufficiently trained junior inspectors to offset the loss of senior inspectors. Furthermore, the junior inspector's experience is generally gained from working with senior inspectors and from on-the-job training opportunities. In many cases it takes more than 10 years to properly transform a junior inspector into a senior inspector. It must be noted that there are existing training opportunities which increase the knowledge and skills of inspectors in regard to asphalt inspection such as the HMA Technician Certification Program. It should also be noted that

junior inspectors are not left on the roadway to perform inspections by themselves if their supervisor feels they are not competent. However, errors are still being made by these inspectors.

It is imperative that the time frame to convert junior inspectors into senior inspectors be shortened.

Implementation Plan:

Based on the above data analysis, the Department's District One construction office needs to improve the process of asphalt roadway inspection in order to enhance the quality of the construction projects. This is critical to enhance customer satisfaction. If a junior inspector is given an opportunity to gain additional knowledge and skills from attending and participating in a class, which is orientated towards teaching the junior inspector those skills necessary to insure a quality asphalt resurfacing job is performed, then hopefully this inspector will become a senior inspector much sooner. The proposed class would consist of teaching those basic items necessary for asphalt inspection, which are currently learned from years of watching and assisting senior inspectors perform their duties. Other items learned from the HMA Technician Certification Program such as asphalt specifications would not be duplicated. Furthermore, this class would review those common types of mistakes made by inspectors that are discovered at the final inspections and the methods and means to insure these errors are prevented from reoccurring.

The successful execution of a class as described above would certainly be one of the first steps in the implementation of improving this process. Process improvement is a difficult task; however, the

rewards are worth the effort. To insure a successful plan is implemented for improving asphalt roadway inspection, the following specific actions must be accomplished⁵:

- Be enthusiastic
- Take risks
- Set the example
- Educate yourself
- Be part of a team
- Take the initiative
- Be part of the solution
- Be prepared for criticism
- Focus on customer and process
- Move from thinking “I” to thinking “We”
- Say what you will do and then do what you say
- Be open to change and try new and different things
- Accept individual responsibility for your own situation
- Do not blame or use excuses as a substitute for personal effort

The District Construction Engineer will develop and employ a class, which would address those numerous items necessary to insure all aspects of a quality asphalt inspection will be performed by inspectors in District One. This class should be held two times each year, and all asphalt inspectors in the District will be required to attend at least one of these two times. One of the reasons the senior and the junior inspectors would both participate in the training is that subsequent to the completion of the class, the senior inspectors could reinforce certain aspects of the materials to the younger inspectors as required during the inspection process. “Sometimes managers mistakenly assume that telling employees is teaching them. Telling is certainly an active part of teaching, although teaching can occur without telling. Demonstrating is one method of teaching without telling. But merely telling and demonstrating is not enough. For learning to occur, it is necessary for trainees to actually practice (simulate) doing the task being taught.”⁶

⁵ Eileen M. Flanigan and Jon Scott, *Process Improvement*, p. 11

⁶ Ferdinand F. Fournies, *why employees don’t do what they’re supposed to do and what to do about it*, p. 12

It is anticipated that all the inspectors would be able to attend by having it administered two times per year. It would be taught during the winter months when the impact to the asphalt roadway inspection would be not as significant. It is anticipated that the duration of the class will be approximately six hours; however, this may vary depending on the amount of participation and discussion. The cost for both the development and implementation of this training should be minimal as all the work will be performed by the District Construction Engineer or his designee and will be held in the Department's facilities. Therefore, all costs associated with this program will be indirect and absorbed by the Department.

The idea of developing and implementing the asphalt resurfacing class was discussed with numerous junior inspectors, senior inspectors, and senior engineers throughout the District. All of these key stakeholders received the idea with open arms. The young junior inspectors especially relished the thought of participating in this class as they felt that the time frame of learning all the necessary points of quality asphalt inspection could be shortened significantly if this training existed. Also, the senior engineers in the District felt that this class would enhance the quality of the work being performed and was necessary. Both senior and junior inspectors were asked to submit different topics and ideas that they would like to be reviewed in this class. These submittals will be the primary focus of the first presentation. The key stakeholders felt that the training should be designed as a power point presentation showing the proper methods of inspecting asphalt roadway projects, and also showing the various errors discovered during the final inspections when proper methods of inspection were not followed. The inspectors want the class to be very interactive with roundtable participation in discussions instead of a lecture type of course. The class would always be a flexible

work in progress tool as different people in different groups would bring forth situations that were not contemplated during the preparation of the original power point presentation. Subsequent to the completion of the class, this presentation will be adjusted, refined and modified as necessary. The initial presentation is attached to this report.

Evaluation Method:

During the presentation, the goal of reducing the number of deficiencies discovered at the final inspections by 25% subsequent to an asphalt resurfacing project will be explained to all the inspectors. Typically, employees fear and mistrust measurements because they either do not understand what or how they are obtained or the measurements are not shared in an open manner. In the presentation to the inspectors, the manner in which measurements are obtained will be made very clear.⁷

After the training session has been administered and the inspectors have had an opportunity to participate in the inspection of a project, the number of deficient items will be measured during the final inspections by the District Construction Engineer. The number of items will then be compared to the number of items found prior to the implementation of the class which averaged 14.5 for junior inspectors and 2.4 for senior inspectors. In addition, all the inspectors will be required to attend the final inspections to listen to the discussions of the senior engineers and learn from these discussions of ways to improve the quality of the work. This attendance will also hopefully reduce the number of deficient items, which are not even placed on the final inspection letters as they were deemed to be uncorrectable or at great inconvenience to the traveling public. The goal of reducing these numbers by 25% will be expected after the inspectors complete the class and their first project. The

⁷ Eileen M. Flanigan and Jon Scott, Process Improvement, p. 32

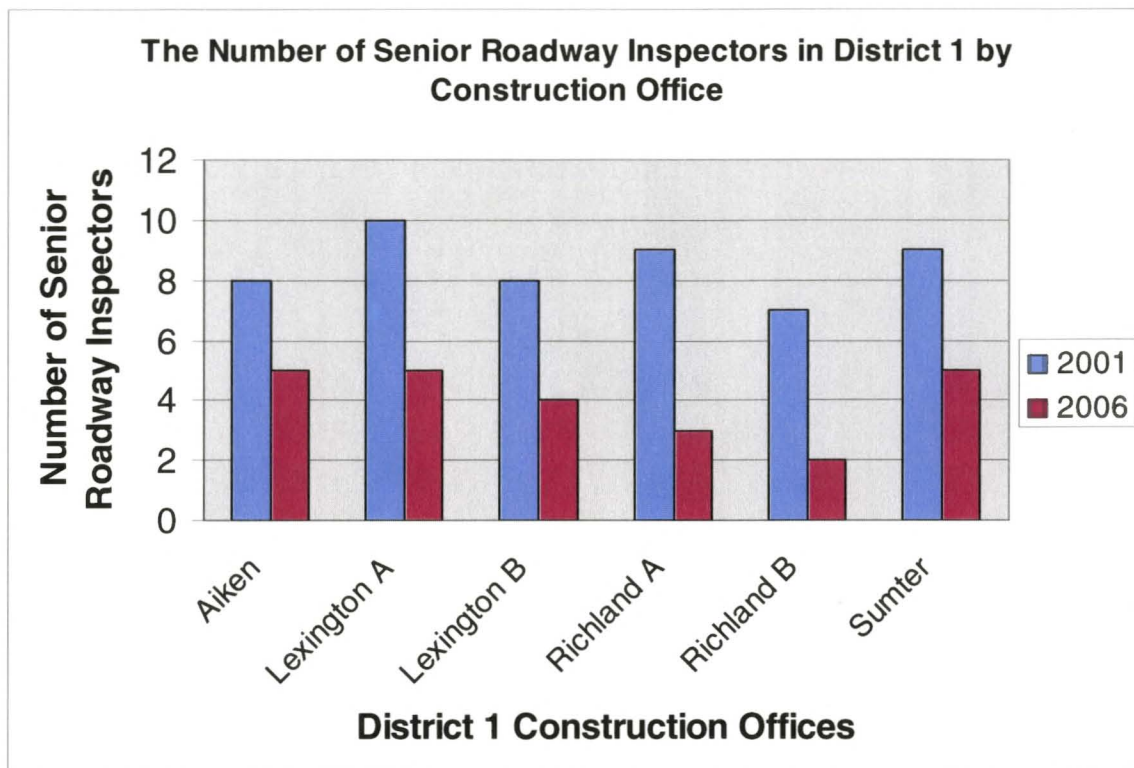
District Construction Engineer will continue to chart the results of these final inspections during 2007 by types of inspectors to determine if the implementation of the class has impacted the quality of the roadway projects.

Conclusion:

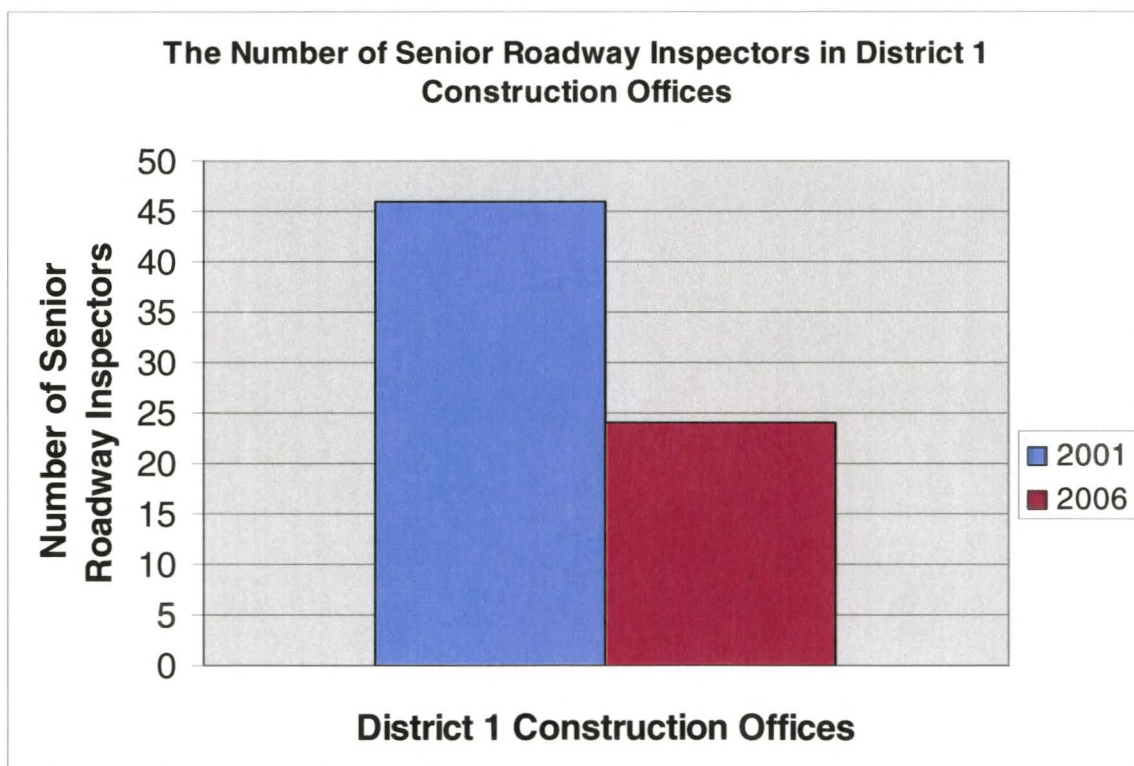
According to Brian Joiner, author of Fourth Generation Management, at least 96% of problems in systems are not the fault of the people. "Blame won't help us get better. We need to de-personalize the problem by improving processes. All one team is an organizational view where everyone from the front lines to the executives understands and acts like they are all on the same team, working together to continually enhance customer satisfaction."⁸

The District One Construction Office will continue to allow asphalt resurfacing projects to be inspected by junior inspectors with proper supervision. It is anticipated that with the implementation of a training class, the quality of the work will be improved. The message to the inspectors will be that this is a big undertaking and with it goes a significant amount of trust and individual responsibility. The entire process will be a team effort, and the ultimate goal is to work together as a team to continually enhance customer satisfaction.

⁸ Brian L. Joiner, Fourth Generation Management

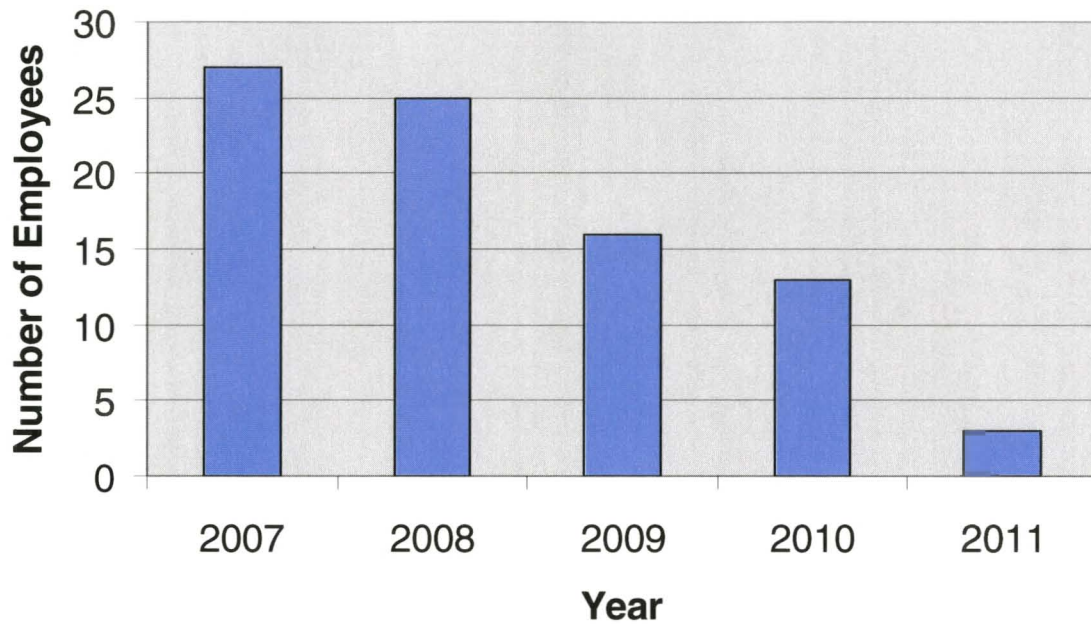


A-1



A-2

**The Number of Employees Who Will
Complete Their TERI Commitment in
the SCDOT Engineering Services
Department**



A-3



A-4



A-5



A-6



A-7



A-8



A-9



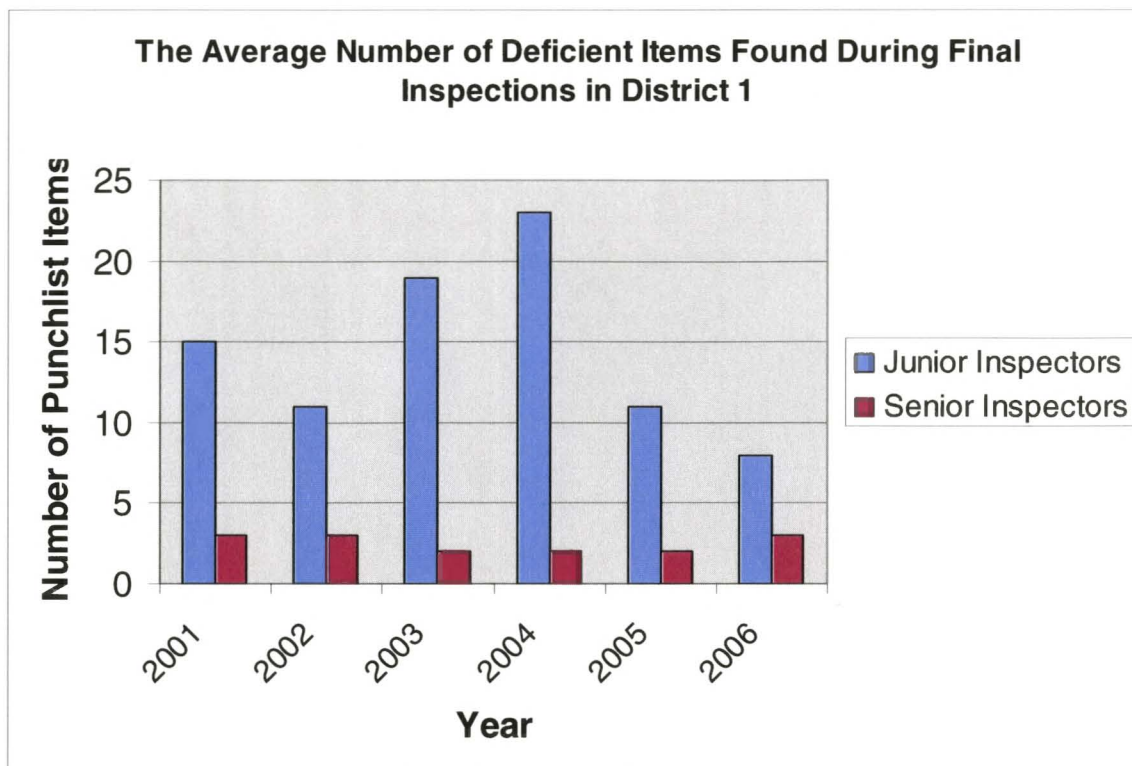
A-10



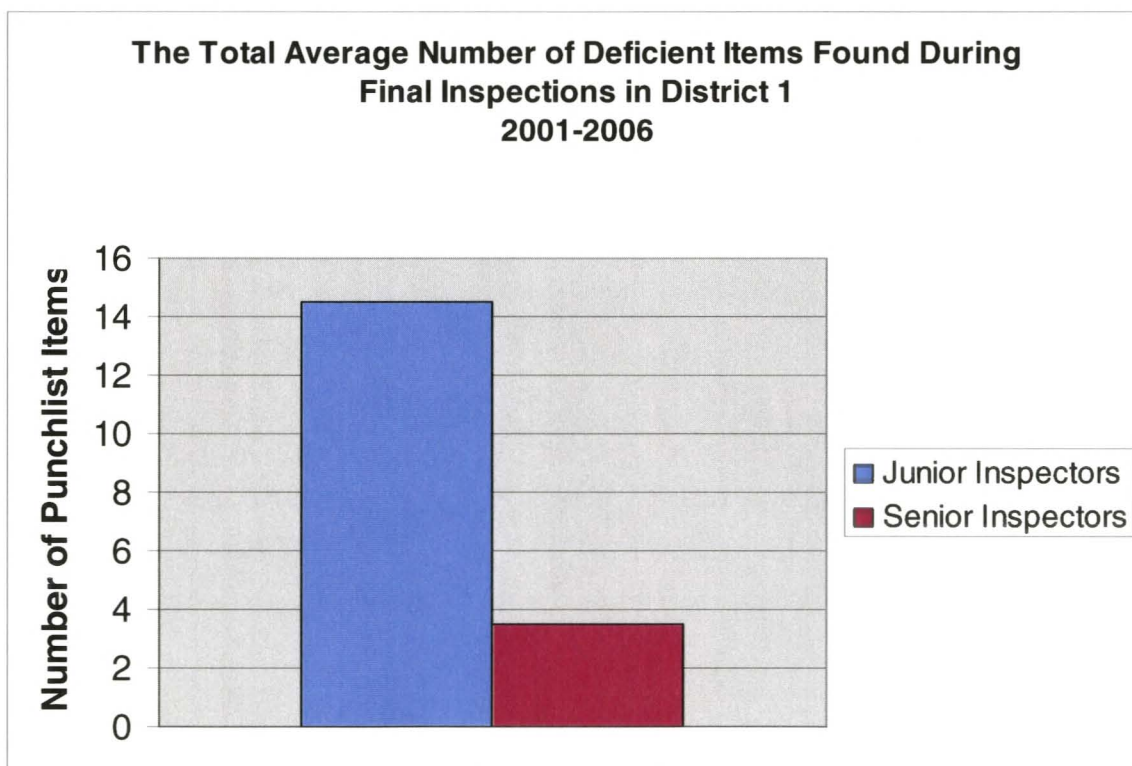
A-11



A-12



A-13



A-14

Asphalt Roadway Inspection Class

Power Point Presentation

Asphalt Roadway Inspection



Prior to the Work Starting



Inspector's Duties in the Office

- Read the Contract & Special Provisions
- Review the Data Sheets (Special Notes) and the Strip Maps
- Review the Types/Rates of Asphalt to be Used
- Attend the Precon & Read the Minutes
- Read the Construction Manual –Section 400

Inspector's Duties in the Field

- Mark Station Numbers
- Document Pavement Marking Locations (Turn arrows, chicken tracks, etc.)
- Determine Discrepancies in Quantities (If any exist notify RCE)

Inspector's Duties in the Field

- Mark for FDP and Leveling (Review with RCE the difference in these areas)



Mark Permanent Construction Sign Locations

- Mark Permanent Construction Sign Locations or Determine if Temporary Can Be Used
- Insure Motorists Can See Signs



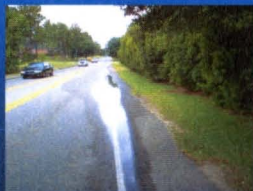
Inspector's Duties in the Field

- Note Conflicts with Utilities (Manholes, water meters, etc.)



Inspector's Duties in the Field

- Inspect the Roadway (Before and after rain)



Inspector's Duties in the Field

- Note Conflicts with Property Owners
- Note Conflicts with Ditches
- Inspect for Cutting Out Driveways – Shoulder Widening
- Inspect for Laying Back Driveways
- Check Cross Slopes – Wedging May be Necessary

Inspector's Duties in the Field

- Milling for butt joints (Look for loops)



Inspector's Duties in the Field

- Milling at Gutter



Discussions with the Contractor

- Work Start Location, Date and Times
- Number of Workers and Equipment
- Special or Unusual Problems Discovered
- Get to Know the Superintendent
- Tell the Contractor what you expect
- Paving with a Threat of Rain
- Review Driveway Paving Policy

During the Work



SCDOT

Inspector's Personal Items

- Calculator, pencils & Clipboard
- Stick Thermometer for truck temps
- Ambient Thermometer
- Infrared Thermometer for Mat Temps
- Measuring Wheel
- Stick Ruler & Measuring Tape
- Copies of Strip Maps
- Spray Paint

Inspector's Duties

- Review Traffic Control Each Day and During the Day



Inspector's Duties

- Obtain Roller Patterns & Verify
- Complete Roadway Report
- Daily Diaries to be thorough (Note locations of FDP & Leveling)
- Rates vs. Thicknesses of Asphalt (108#/in/sy or 200#/sy=1-7/8")
- Inspect Equipment for Hydraulic Leaks

Inspector's Duties

- Take Hourly Temperatures for Trucks, Mat & Air (Reject if necessary)
- Type and Temperature of Tack
- Core Locations
- Insure Roadway is Clean

Inspector's Duties

- Calculate Asphalt Rates Every 200 tons on Interstate Projects but More Often (3-4 truck loads to keep rates down) on Other Projects
- Calculate Tack Rates (.05 to .15 gal/sy)



Inspector's Duties

- Paving of Driveways for Proper Tie In with Main Line



Inspector's Duties

- Sign Truck Tickets
- Check Screed for Crown and Wear and Vibrators are Functioning Properly
- Walk Along Side of the Paver

Inspector's Duties

- Inspect Quality of Mix: debris, segregation, too rich, lumps, etc.



Inspector's Duties

- Check Depth of Asphalt with Ruler in Several Locations Behind Paver
- Level Roads with Rutted Wheel Paths to Prevent Slipping and to Insure Compaction
- Maximum Compacted Thickness of lifts: Base=4-1/2", Binder=3" and Surface=2"
- Overlap Joints in the Layers Min. 6"
- Multiple Lifts in a Day - Temp of Interior Mat less than 175 degrees

Inspector's Duties

- Small Potholes to be Repaired in Front of the Paver
- Remove RPMs



Inspector's Duties

- Watch Edges for Straightness
- Eliminate Drop-Offs Within 3 Days
- Edge to be Established by String Line



Inspector's Duties

- Insure Paver
Continues to Move
and Does Not Stop
While Waiting on
Trucks
- Insure Trucks do
not Bump Paver



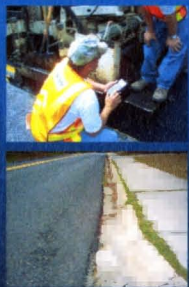
Inspector's Duties

- Inspect Rollers for
Speed and # of
Passes (critical for
compaction)



Inspector's Duties

- Segregation - End
Load and
Temperature (Walk
behind the paver
and pay attention
to the mix)



Inspector's Duties

- 6" Full Depth Patching
- Mark Areas – Minimum 6' wide x 6' long (No closer than 25')



Inspector's Duties

- Remove Areas and Tack Sides (Edges to be neat and clean)



Inspector's Duties

- Fill Area in 2 Equal 3" Lifts (Compact between lifts)



Inspector's Duties

- Compact Each Lift



Inspector's Duties

- Insure Area is Level and Ride is Smooth



Inspector's Duties

- Clean Asphalt Debris from Sidewalks, Medians, Gutters, etc. in a Timely Manner



Inspector's Duties

- Insure Pavement Markings are Placed Properly



Inspector's Duties

- Insure Borrow is Placed Properly to Prevent Drop-Offs



Inspector's Duties

- Insure Grassing is Per Specs